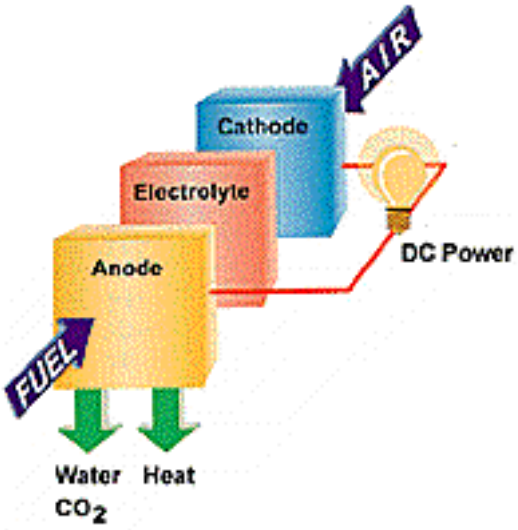
# About Hybrid Electric Vehicles

Some hybrid electric vehicles (HEVs) combine a conventional internal combustion engine (using gasoline, diesel, natural gas, ethanol, or other fuel) with the battery and electric propulsion motor of an electric vehicle. Other hybrids combine a fuel cell with batteries to power electric propulsion motors.

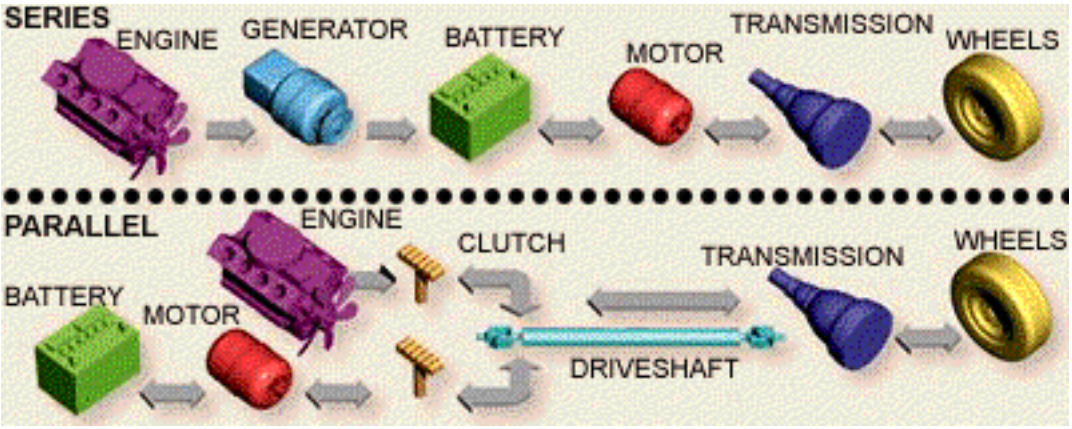



Hybrids are generally designed as either series of parallel hybrids, depending on how the internal combustion engine (ICE) is used. In the series mode, the engine drives a generator that charges the batteries and provides electricity to the electric motor, which turns the wheels either with or without a transmission. In the parallel mode, the ICE, or the electric motor, or both, turn the wheels. The ICE also charges the battery. If an HEV has a fuel cell, the electricity generated by the fuel cell can be used to charge the batteries and power the electric motor, which turns the wheels.

Hybrid vehicles combine the range and rapid refueling that consumers expect from a conventional ICE vehicle with some of the energy savings and environmental benefits of an electric vehicle. The practical benefits of HEVs include improved fuel economy and lower emissions compared to conventional ICE vehicles.

Hydrogen fuel cells generate electric power by combining hydrogen and oxygen in an electrochemical device that operates without combustion, so they are pollution free and the only by-products are water and heat. Fuel cells that use other fuels can have additional by-products such as carbon dioxide and carbon monoxide.

Since hydrogen fuel is converted directly to electricity, a fuel cell can operate at much higher efficiencies than internal combustion engines, extracting more energy from the same amount of fuel. The fuel cell itself has no moving parts, making it a quiet and reliable source of power. Fuel cells produce DC voltage that can be used to power motors and lights, and charge batteries. Originally developed in the 1800s, fuel cells have been used in the U.S. space program since the 1950s and have the potential to replace internal combustion engines in many applications.




The Advanced Vehicle Testing Activity has performed initial Pomona Loop testing on the Honda Insight and Toyota Prius HEVs. These initial tests are used to refine the Hybrid EVAmerica Baseline Performance testing procedures to incorporate the lessons learned. Several HEV models have entered Baseline Performance, Accelerated Reliability and Fleet testing and the results have been reported since 2001.

Hybrid electric vehicles (HEV) require their own test procedures given their various operating scenarios. For instance, should HEVs be tested in pure electric modes, combined modes, or only in drive cycles when internal combustion engines provide energy and power? The Program has developed Hybrid EVAmerica testing procedures that incorporate these and other operating scenarios.

Testing changes include testing HEVs when they are operated in the “rechargeable energy storage system” (RESS) mode if capable of being driven in RESS mode only. This allows an HEV’s “pure electric” range to be measured. HEVs will also be tested in the manufacturer-specified normal operating (combined) mode with testing to commence at 100% state-of-charge. When applicable, both miles-per-gallon of fuel and the miles-per-kWh will be captured as well as the HEV’s range when operated in pure electric mode.